



# Econometric analysis of air passenger demand in Nigeria

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## Article History

Received: 29 June 2020

Reviewed: 30/June/2020 to 07/August/2020

Accepted: 08 August 2020

Prepared: 12 August 2020

Published: September 2020

## Citation

Oladun, Emmanuel A, Ayantoyinbo, Benedict B. Econometric analysis of air passenger demand in Nigeria. *Discovery*, 2020, 56(297), 620-627

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## General Note



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## ABSTRACT

Broadly, transport economics and air transport economics in specific can be considered to be the engine of economic activity because of its derived nature. It is pertinent to note that an increase in economic activities will inevitably result in an increasing need for transport. The study aimed at examining the econometric analysis of air passenger transport in Nigeria. The study adopted a combination of descriptive and inferential statistics, and it relied on information obtained from secondary sources especially published relevant government institutions and agencies in Nigeria. Econometric model was employed to estimate the contributions of air passenger demand on the economy. Observatory data were gathered on international and domestic air passenger demand between year 2009 and 2018 (10 years) from the FAAN. Also, observatory data were collected on GDP and GNI between the same periods. The study found a weak correlation between air passenger travel demand and economic indices. Also air passenger travel demand contributes little to GNI and GDP by 9.4 percent. This is an implication that air passenger travel has little or no contribution to the nations' GNI and GDP. It is therefore recommended that there should be better fare policies which will enable more passengers to travel.

**Keywords:** econometric model; transport; air transport; air passenger demand

## 1. BACKGROUND TO THE STUDY

In the 21<sup>st</sup> century, the contribution of air transportation in enhancement of mobility has been significant. This gives room for regional complementarity of goods and services across locations, intervening opportunities, and spatial transferability. Air transport has been able to connect cities, enhance travel opportunities to several places in the world and, as a result stimulate socio-economic and political development. The demand for air transportation has been significantly achieved through offering of quick transportation between origins and destinations at the global level when comparison to other modes of transportation, particularly on longer distances.

Air transport has a vital contribution in the travel and tourism industry, most especially with the increasing competition and advancing technology in place, air transportation became more affordable to wider ray of tourists (Sultan and Simpson, 2000; Sai, Ekit, and Kamarulzaman, 2011). In the developed and the developing economies, the roles of air transport sector in an economy cannot be overemphasized. In service industries of the world, the contributions of air transport cannot be left aside because of its derived and heterogeneous nature. Its technicality proves it to be a major contributor to the development of societal development in recent time.

In fact, the technological expansion in the aviation sector cannot be compared to any other transport modes. This is because of its technicality and new innovations that is persistent in the sector such as the use of Global Distribution System (GDS), Computer Reservation System (CRS), Visual Docking Guidance System (VGDS), Common User Passenger Processing System (CUPPS), Baggage Reconciliation System (BRS), Passenger Tracking System (PAXTRACK), and others. The technological advancements in the aviation industry have enhanced the development of tourism at the national, regional, and global level.

Demand for air travel services has increased the influence of air transport in the nation and global economy, thereby enhancing rapid movement of passengers, goods and services in the domestic and world market. The effect of this is the enhancement of more revenue generation to the national economy through the quick inflow and outflow of goods and services occasioned by foreign direct investment (FDI) (Ladele, 2012). Along-side to the globalization progression in the world, air transportation has proven to be the most pertinent, useful, reliable, fastest, and safest mean of transport over a longer distance most especially from one county to another. Also, it enhances the rapid rate of urbanization which enables spatial interaction of goods and people over a geographical space (Airbus, 2011). While economy (global Gross Domestic Product - GDP) is expected to grow at an average rate of 3.3 percent annually for the next 20 years, global air passenger traffic growth is forecasted higher than GDP growth (Boeing Current Market Outlook, 2011). In the same regard, it is projected to be around 5.1 percent per annum from 2011-2030; it can also be stated that air traffic will be two times more than the projected in 15 years time.

In spite of the slow expansion of air transportation in budding regions such as the Western Europe and North America, promising economies such as Middle East regions and China will attract air transport growth. For example, the rate of air traffic growth is anticipated to be 6.8 percent in Latin America, and 7.0 percent in the Asia-Pacific, while it is forecasted to be 2.3 percent for North America. BRIC (Brazil, Russia, India, and China) economies and other emerging economies are anticipated to contribute 56 percent of world economic growth in the coming 20 years; this means that these regions and economies will be the main growth driver of the air transportation in the coming decades (Airbus, 2011).

Passenger traffic, aircraft traffic, and freight traffic have witnessed a tremendous growth as a result of the dynamics of physical and economic development of cities in many parts of the world and has relatively spur the disposable income of individuals directly or indirectly. The conception of states and the urge to establish state capitals for those states so that they can have control over their socio-economic responsibilities has brought about the stroke of physical development in Nigeria. As a result of this, airports were being developed in many State capitals to enhance ease of administration and security, and the attraction of foreign direct investments. There is significant connections between the different economic spaces which are best facilitated by air transportation (Aderamo, 2010). Also, the recent civilian government identified the air transport system as a catalyst to expose the country to many foreign investors and thereby fine the fissure between the required capital of domestic investment and the available capital of domestic investment (Adeyemi 2001).

The air mode of transportation at the commercial level is very well recent in Nigeria when compared with the road and railway modes of transportation. The contribution of air transport to the development of mobility in Nigeria is commendable. For example, in 1988, the domestic passenger traffic was about three million, which rose to about five million in 1998 and about seven million in 2004 (Aderamo, 2006), and about fifteen million in 2019. Similarly, both air cargo and air mail had been on the increase (Federal Ministry of Transport (FMT), 2004). All these are pointers to the fact that there is increasing demand for air transport in the country.

To accommodate subsequent demand for air transport services in Nigeria, there is a need for proper planning. The long term of successes recorded in most organization is closely attached to proper management such that there is balance in demand and supply.

Acknowledging the econometric analysis of air transport demand is quite pertinent as Nigerian government is trying to accommodate the air transport growth by rebuilding its infrastructure. Currently, Nigerian government is trying to rebuild and renovate the existing airports throughout the nation so as to increase their capacity for instance in Murtala Muhammed International Airport, Lagos and Port Harcourt International Airport, Port Harcourt, and most recently the repair work on the runway of Nnamdi Azikiwe International Airport, Abuja. The economic implication of this expansion repairs and expansion is needed to be determined so that more investment can set in.

The air transport industry also have significant role particularly for social and leisure purposes around the globe. The sector enhances improved quality of life, social networking, and standard of living within the nation. All this helps to generate economic growth and poverty alleviation by way of providing employment opportunities, increasing revenues from taxes (Adeniran and Ben, 2017). Employment would be realized through supply chain dynamics and airport transformations. As a result of this, the industry becomes the gateway to the economy of any nation that is aspiring to develop, through an enabled globalization, trade and tourism development.

The effects of air transportation on development and economic growth of the nation cannot be over-emphasized. Although, in Nigeria the contribution of aviation to GDP is small (less than 5 percent) compared with other sectors of the economy (Stephens, Ikeogu, Stephens, and Ukpere, 2014). Majority of the studies have adopted GDP to measure the performance of economy and its impact from air transportation without considering the Gross National Income (GNI). On this note, this study will therefore examine the contribution of air passenger demand on the Nigerian economy based on Gross National Income (GNI) and Gross Domestic Product (GDP).

Among the related studies conducted are, the study of Fridström and Thune-Larsen (1989) focused on forecasting air traffic volumes in Norwegian domestic air transportation network. The study of Alperovich and Machnes (1994) increased the understanding of multiple dimensions of air travel. Also, Sai *et al.* (2011) examined factors determining the choice of full service airlines and low cost carriers using the case of Malaysia. Ukpere *et al.* (2012) examined the dynamics in the choice of air travelers' decision to choose domestic airlines to fly within Nigeria using data collected from 15,802 air travelers with questionnaires on Likert scale ranking.

Nwaogbe *et al.* (2013) carried out a study on the analysis of the impact of air transport sector on economic development in Nigeria. Ayantoyinbo (2015) evaluated Nigeria domestic airline services that are preferred by numerous airline passengers in Nigeria using data collected from 550 air travelers with questionnaires through random sampling technique. Ayantoyinbo (2015) further examined the factors that contribute to the occurrence of flight delay in Murtala Muhammed International Airport, Lagos Nigeria using thirty two airlines operators that were purposively selected. Aleksandra (2016) conducted a study on the factors influencing passengers' choice of transport mode to Warsaw Chopin Airport. Adeniran and Ben (2017) emphasized on the econometric modeling of domestic air travel demand in Nigeria. Ayantoyinbo (2018) conducted a research to identify factors inhibiting aviation cargo logistics based on twenty four variables. Adenigbo (2016) conducted a study on the factors influencing cargo agents choice of operations in Abuja airport, Nigeria. Most of the earlier studies may not have captured the impact of air travel demand on Gross National Income (GNI) and Gross Domestic Product (GDP). In order to fill these lacunas, this study is set to examine the econometric analysis of air passenger demand in Nigeria by considering Gross National Income (GNI) and Gross Domestic Product (GDP).

Econometric analysis is the quantitative application of statistical and mathematical models using data to establish models, formulate and test assertions in economics for the purpose of making future predictions from historical observatory data. It usually relies on techniques such as regression models and null hypothesis testing (Hayes, 2019). Gross Domestic Product (GDP) is a worldwide adopted measure to determine the strength and size of economy. It can also be defined as the total monetary value or market value of all finished goods and services that is manufactured within a country in a particular time (Kramer, 2020). Gross National Income (GNI) is a worldwide adopted measure to track a nation's wealth performance periodically. It is the total amount of money that is realized from the country's businesses. It entails the total nation's gross domestic product and income that was received from overseas sources (Chappelow, 2020).

## 2. METHODOLOGY

This design for this research is achieved through the combination of descriptive and inferential statistics, and it relied on information obtained from secondary sources especially published relevant government institutions and agencies in Nigeria. The hypotheses will

be established with Ordinary Least Square (OLS) regression. The study adopts econometric model to estimate the contributions of air passenger demand on the economy. The following steps of econometric model are:

### **Model specification or Model formulation**

In the model specification or model formulation, mathematical model will be initially specified before the formulation of econometric model. Without deriving the mathematical model, the econometric model cannot be derived. The difference between the mathematical model and the econometric model is the inclusion of stochastic disturbance term, which is also referred to as unexplained variables or error term in the econometric model.

### **Mathematical models:**

$$\text{Air}_{\text{Pax}} = t + D_1(\text{GDP}) + D_2(\text{GNI}) \dots\dots\dots(\text{Equation 1})$$

### **Econometric models:**

$$\text{Air}_{\text{Pax}} = t + D_1(\text{GDP}) + D_2(\text{GNI}) + U_i, \dots\dots\dots(\text{Equation 2})$$

Where:

$\text{Air}_{\text{Pax}}$  = Air Passenger Traffic (international and domestic) (Dependent variable)

$t$  = Intercept

$D_1$  = Regression coefficient for GDP

GDP = Percentage change in Gross Domestic Product

$D_2$  = Regression coefficient for GNI

GNI = Percentage change in Gross National Income

$U_i$  = Unexplained variables, stochastic disturbance term or error term which accounts for other economic factors influencing air passenger demand.

### **Collection of appropriate data based on the specified or formulated model**

In this study, observatory data were collected on international and domestic air passengers that travelled between year 2000 and 2019 (20 years) from the FAAN. Also, observatory data were collected on GDP and GNI between the same periods from NBS and confirmed in the World Bank data.

### **Model estimation**

Econometric model is estimated to give model satisfaction and reliability. This was achieved with the use of Ordinary Least Square (OLS) regression to reveal the differences between the true line and the observed line (error or residual). Ordinary Least Square (OLS) regression, which is also referred to as regression, is a constructive parametric tool that is usually adopted for examining the relationship between two or more variables if and only if the data types are interval scale or ratio scale of measurement. There is an assumption that OLS regression requires a linear relationship between the two or more variables, such that if the relationship is not linear OLS regression may not be suitable for ideal analysis. If the relationship is not linear, the variables may be modified. The principal idea behind this is that, if there is a linear relationship between two variables, one variable can be used to predict the values of the other variable.

### **Validity of the model**

Validity of the model is needed to find out if the model will give a true forecast. It can be achieved through the following:

- **Test of significance**

This is crucial in research analysis. Adeniran and Ben (2017) used a slimily approach in their study that as methodology is the heart of a research work, so also is significance test the heart of model estimation. It is usually assumed that the null hypothesis would be rejected and the alternate hypothesis would be affirmed if the computed probabilistic value (*p value*) is less than the chosen error probability. Otherwise, the null hypothesis will not be rejected and the alternate hypothesis will be rejected. If the null hypothesis is rejected, the model will give a good forecast. However, it is not only dependent on the test of significance, other tests are:

- **Tests for homoscedasticity and multicollinearity**

Homoscedasticity usually occur when two variables are highly or near perfectly correlated, i.e. R more than 80 percent (Greene, 2003). Multicollinearity is suspected if the coefficient of determination (R-squared) is greater than 0.85. Standard errors, correlation coefficient, and overall coefficient of determination may be used for testing Homoscedasticity and Multicollinearity.

- *Goodness of fit test*

The goodness of fit test can be referred to as the summary of statistics, which indicates the precision, and appropriateness of the estimated model. It is also referred to as the regression proper. It shows the ratio of explained and unexplained variables. In the situation whereby the explained is more than the unexplained, the model is good. If otherwise, the model is not suitable for forecast.

### 3. RESULTS AND DISCUSSION

#### *Trend Analysis of Air Travel Demand, GNI and GDP*

From the Table 1, it can be deduced that there was a sharp fall in the international and domestic passenger travel in the year 2009. Although the passenger travel picked up in the year 2010 and keep rising to about 4.8 percent in the year 2014. Both inbound and outbound passenger traffic. The implication of this is that, the nations' economy is possible to be in a fluctuating pattern. From the same table, it could be deduced that domestic air passenger travel market in Nigeria is flourishing as there are more passengers travelling. However, there is need for better fare policies that will enable more passengers such that it will be three times higher than the international air travel market.

**Table 1.** Air passenger demand

Year	International Passengers	Domestic Passengers	Total Passengers
Yr 2009	3, 012, 726	9, 513, 738	12, 526, 464
Yr 2010	3, 227, 952	10, 753, 725	13, 981, 677
Yr 2011	3, 586, 742	11, 303, 216	14, 889, 958
Yr 2012	4, 440, 930	9, 675, 860	14, 116, 790
Yr 2013	4, 567, 240	10, 074, 528	14, 641, 768
Yr 2014	4, 605, 671	10, 780, 804	15, 386, 475
Yr 2015	4, 353, 033	10, 390, 038	14, 743, 071
Yr 2016	4, 249, 363	9, 671, 612	13, 920, 975
Yr 2017	4, 056, 717	10, 383, 452	14, 440, 169
Yr 2018	4, 438, 799	12, 791, 639	17, 230, 438

Source: Federal Airports Authority of Nigeria (2008)

#### *Impact of Air Travel Demand on GNI and GDP*

When examining the impact of air travel demand on GNI and GDP, there is need to be conscious of the fact that the air travel demand was captured with the summation of domestic and international air passenger travel in Nigeria. This objective addressed the first and the second hypotheses which state thus:

H<sub>01</sub>: There is no statistical significant relationship between air passenger demand and Gross Domestic Product (GDP); and

H<sub>02</sub>: There is no statistical significant relationship between air passenger demand and Gross National Income (GNI).

As shown below in the econometric modeling equation, Ordinary Least Square (OLS) regression was adopted.

$$\text{Air}_{\text{Pax}} = t + D_1(\text{GDP}) + D_2(\text{GNI}) + U_i \dots\dots\dots(\text{Equation 2})$$

In order to analyze this, the total air passenger travel is the dependent variable, while the GDP and GNI are the independent variables or predictors. The secondary data has the occurrence or data scope of ten (10) years from 2009-2018, and was standardized, perfected and converted into percentage changes as shown in Table 3. The hypothetical analysis was shown in Table 4, Table 5 and Table 6.

For the aggregate regression and correlation analysis that was shown in Table 4, correlation value (R) of 0.307 implies that there is a weak and positive causal relationship between the air passenger travel and the independent variables (GNI and GDP). From the same Table 4, the aggregated regression value of 0.094 implies that 9.4 percent of the air passenger travel demand is explained by

GNI and GDP. In other words, air passenger travel demand contributes little to GNI and GDP by 9.4 percent. This is an implication that air passenger travel has little or no contribution to the nations' GNI and GDP. Hence, the demand for air passenger travel may not be a good variable to determine how the economy is performing.

The level of significance that is P value of 0.743, when compared with the critical region 0.05, it was revealed that P value is more than critical region as shown in Table 3. Hence, there can be no rejection on the null hypothesis which states that there is no significant relationship between air passenger demand and the economic indices (GNI and GDP) in Nigeria. This non rejection is further affirmed in the correlation and regression coefficient values.

As shown in Table 4, given all the predictor variables constant at zero (0), air passenger travel demand will be 2.054. This positive and low value signifies that the predictors cannot give true estimate of the forecast. On the other side, the regression coefficient for GNI is -0.463. This means that the air passenger travel demand has negative contribution to GNI. In addition, the regression coefficient for GDP is -0.950. This means that air passenger travel demand has negative contribution to GDP. In a nut shell, both GNI and GDP cannot be predicted with air passenger travel demand in Nigeria. If forecasted, it will not give a true forecast. The econometric model that is unfit goes thus:

$$\text{AirPax} = 2.054 - 0.463\text{GDP} - 0.950\text{GNI} + U_i$$

**Table 2.** Percentage change of total passengers, GNI and nominal GDP from 2010 to 2018

Year	percent Change of Passenger Traffic	percent Change of GNI	percent Change of GDP
Yr 2010	10.41	5.24	-2.02
Yr 2011	6.1	-2.92	-1.84
Yr 2012	-5.48	4.301	-1.36
Yr 2013	3.585	2.105	-1.44
Yr 2014	4.84	4.427	-0.94
Yr 2015	-4.36	6.579	-1.65
Yr 2016	-5.91	-0.76	-2.63
Yr 2017	3.595	-3.13	-3.17
Yr 2018	16.19	-1.79	-2.84

Source: Authors' computation; World Bank (2020)

**Table 3.** Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.307(a)	.094	-.208	8.21980

a Predictors: (Constant), GDP, GNI

Source: SPSS Version 21

**Table 4.** ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.222	2	21.111	.312	.743(a)
	Residual	405.391	6	67.565		
	Total	447.613	8			

a Predictors: (Constant), GDP, GNI

b Dependent Variable: Passenger

Source: SPSS Version 21

**Table 5.** Coefficients (a)

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.
		B	Std. Error	Beta		B	Std. Error
1	(Constant)	2.054	12.434			.165	.874

	GNI	-.463	1.086	-.233	-.426	.685
	GDP	-.950	5.471	-.095	-.174	.868

a Dependent Variable: Passenger

Source: SPSS Version 21

#### 4. CONCLUSION

Transport economics and air transport economics in specific can be considered to be the engine of economic activity because of its derived nature. It is pertinent to note that an increase in economic activities will inevitably result in an increasing need for transport. The study aimed at examining the econometric analysis of air passenger transport in Nigeria.

The study adopted a combination of descriptive and inferential statistics, and it relied on information obtained from secondary sources especially published relevant government institutions and agencies in Nigeria. Econometric model was employed to estimate the contributions of air passenger demand on the economy. Observatory data were gathered on international and domestic air passenger demand between year 2009 and 2018 (10 years) from the FAAN. Also, observatory data were collected on GDP and GNI between the same periods.

The study found a weak correlation between air passenger travel demand and economic indices. Also air passenger travel demand contributes little to GNI and GDP by 9.4 percent. This is an implication that air passenger travel has little or no contribution to the nations' GNI and GDP. It is therefore recommended that there should be better fare policies which will enable more passengers to travel.

#### Funding:

This study has not received any external funding.

#### Conflict of Interest:

The authors declare that there are no conflicts of interests.

#### Peer-review:

External peer-review was done through double-blind method.

#### Data and materials availability:

All data associated with this study are present in the paper.

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